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THE IDENTITY OF FLAGSTAFFITE AND TERPIN HYDRATE

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The writer recently described¹ a new organic mineral from Arizona and in discussing its paragenesis suggested that it had been formed, thru oxidation or hydration, from the natural resins of the buried logs in which it was found. At that time, however, a search among the synthetic terpenes and related compounds failed to bring to light anything that corresponded exactly to the writer's analysis and crystallographic measurements. Later Dr. Francis D. Dodge, of Brooklyn, suggested² that the mineral might be identical with terpin hydrate, a well known synthetic product of the laboratory, but unknown as a natural substance.

Careful comparative tests have therefore been made with the limited amount of flagstaffite available, with the result that both crystallographically and chemically the two substances have been found to be identical. Dr. Dodge called the writer's attention to the fact that if the published *b* axis of terpin hydrate was made equivalent to the writer's *a* axis, or vice versa, the crystals yielded the same goniometric values. This is illustrated in the table below, the measurements of Maskelyne being taken for comparison, after converting them into two-circle angles and changing the orientation to suit that adopted by the writer for flagstaffite.³

¹ F. N. Guild. Flagstaffite, A New Mineral from Arizona. *Am. Min.*, 5, 169, 1920.

² Personal communication to the Editor.

³ Maskelyne, *Z. Kryst. Min.*, 5, 644; Groth, *Chem. Kryst.*, III, 658.

TABLE 1

<i>Terpin Hydrate, Maskelyne</i>			<i>Flagstaffite, Guild</i>		
Letter	φ	ρ	Letter	φ	ρ
q	90° 00'	25° 39'	o	90° 00'	25° 40'
b	90 00	90 00	a	90 00	90 00
m	38 56	90 00	m	38 58	90 00
o	38 56	37 24	p	38 58	37 26

The writer's formula for flagstaffite derived from chemical analysis and molecular weight determination was given as $C_{12}H_{24}O_3$. The accepted formula for terpin hydrate is $C_{10}H_{22}O_3$, ($C_{10}H_{20}O_2 + H_2O$) and this should now be taken as the corrected formula for flagstaffite. In view of the new data now available the original analysis may be handled as suggested below:

	Per Cent.	Ratio	Ratio $\times 10/5.52$
C	66.21	5.52	10.0
H	11.55	11.45	20.7
O	22.24	1.39	2.5

This analysis, then, could well correspond to terpin hydrate partially dehydrated by standing for a time over sulfuric acid.

Further work on melting points shows that when parallel tests are made on the two substances, giving each the same treatment, identical results are obtained. On either substance variable results may be obtained, mainly depending upon the time of heating. This is due to the fact that terpin hydrate loses water before melting and the mixture fuses at lower temperatures. If the substances are heated very slowly they soften slightly above 100° and finally melt completely in the neighborhood of 116°. The anhydrous terpin from flagstaffite was found to melt at 105°. This corresponds to the synthetic terpin.

The theoretical molecular weight of terpin hydrate is 190, while 210 was found on the natural substance recrystallized from alcohol. No explanation for this divergence has been found, but it is after all not sufficient to negative the conclusion from the other data. Many qualitative tests were applied to the two products and in every case they appeared identical.

Crystals of flagstaffite, recrystallized from alcohol, were found to be optically positive and $\rho > v$. This also corresponds to the published data on terpin hydrate.

Terpin hydrate is easily prepared in the laboratory by allowing turpentine oil to stand for a long time in the air, in contact with

water (altho it may be prepared more quickly by adding nitric acid and alcohol to this mixture). It is, then, strange that this substance should not have been found earlier in nature. The discovery of flagstaffite in buried logs is therefore of double interest since it adds a new mineral species and brings to light a natural product that formerly was supposed to be only the product of the synthetic laboratory.

These investigations emphasize also the value of crystallographic measurement in chemical research. While the chemical data described above are somewhat conflicting, the crystallographic data on the two substances are in perfect harmony. Correspondence of crystal form (if the crystals are measurable with reasonable accuracy), is an excellent criterion of the identity of chemical substances, applicable in many branches of chemical work.

THE UNIONVILLE, PENNSYLVANIA, CORUNDUM MINES

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Cambridge, Mass.

Conspicuous among the minerals of the larger collections of the eastern United States are the brilliant "fawn-colored" crystals of diaspore from Unionville, Chester Co., Pa. The locality is, furthermore, a classic one for corundum, which has been mined in considerable quantities; and due to the zeal of the early Chester County mineralogists, it was the type locality for some five mineral species (all since reduced to the status of varieties): Euphyllite, pattersonite, lesleyite, unionite and corundellite.

The mines have been abandoned since the end of the last century, but the dumps, residual ledges, and boulders still yield a number of interesting corundum-associates and serpentine minerals.

Corundum is still to be found, chiefly in weathered boulders which appear innocent enough on the outer surface, but on investigation show cleavable crystals imbedded among scales of margarite. A few years ago the writer found a boulder of black tourmaline which was penetrated by long grayish-white corundum crystals, associated with pearly euphyllite. On the same visit,

William Ball, owner of the property on which the mines are located, pointed out in the corner of a stone wall a boulder of corundum some 6 decimeters in diameter.

The "Barrens" of Newlin Township are locally conspicuous because of their rugged topography, the steep bare hillsides presenting a striking contrast to the fertile farmland of the surrounding districts. Numerous scrub cedars, greenbrier, and the vernal glow of mountain pink are striking features of the flora that characterizes the serpentine areas of the Pennsylvania Piedmont.

Geology.—The corundum is associated with an area of serpentine about 2 kilometers long and one km. wide, one of many in the vicinity, representing the metamorphosed phase of original peridotite and pyroxenite intrusions associated with gabbro and norite in the gneissic rocks of the region. Both the serpentine and the surrounding mica gneiss are cut by pegmatite dikes, in which quarries for feldspar at nearby localities have yielded fine crystals of beryl and tourmaline. Intimate association of tourmaline with the corundum suggests pneumatolytic action and implies a genetic connection of the corundum with the pegmatite, which occurs very close to the shaft from which most of the corundum was taken. Unfortunately structural relations cannot now be observed and the older literature is not very clear on the matter, altho it is repeatedly stated that the corundum was found "in granular albite." The Conshohocken diabase dike (Triassic) passes close to the mines.

History.—Corundum is said to have been discovered at this locality by John and Joel Bailey, in 1822¹ at which time local farmers were greatly inconvenienced by great lumps of rock too hard to drill for blasting. These were finally disposed of by digging holes near the boulders and burying them at a sufficient depth to avoid their interfering with the plow. "In 1848, Mr. Lewis W. Williams sent to Liverpool a large lump of the mineral which weighed more than 5,200 pounds." In 1872, a large mass was discovered weighing about 200 tons. This, according to Willcox, occurred on the margin of the serpentine bed against a wall of gneiss rock on the north side. The corundum was worked at various times during the last century. Jefferis says:²

"A number of excavations were made on the north side of the ridge. In one of them was found a vein 14 feet long, 7 feet

¹ Lesley, J. P. Second Geological Survey of Penna., *Rept.* C4, 349.

² Jefferis, W. W. *Proc. Acad. Nat. Sci. Phila.*, 1892, 187.

wide, and 54 feet deep, a solid mass of corundum and emerylite; on one side of it was a coating of diaspore, 3 x 2 feet and 2 inches thick, well crystallized on the surface, some of the crystals being two inches long."

In 1892 the deposit was being worked by a Philadelphia company.

Location.—The workings are situated in Newlin Township, Chester county, Penna., $2\frac{1}{2}$ km. northeast of Unionville, on the road to Northbrook. (On the coördinate system of Kemp, the location is West Chester Quadrangle, 1879 and 4218.) Here three roads form a small triangle on the high ridge of serpentine, affording a fine view of the Brandywine valley. Within this triangle are the ruins of the mine buildings, and across the road in the woods to the south are the old shafts and prospecting ditches. Across the small valley to the north are other prospects.

The best locality for beryl at present is near John Updegrove's house (West Chester Quadrangle 1879) on "Beryl Hill," just west of the road running southward along the ridge from Glen Hall Station. Here lumps of beryl can be found in the lane and in the pegmatite of the small quarry west of the house.

List of Minerals.—A complete list of the minerals of this locality, with critical notes and references, is to be included in the forthcoming "Mineralogy of Pennsylvania," in preparation by Samuel G. Gordon. An alphabetical list is all that will be given here: Albite, allanite?, amphibole (vars. mountain cork and actinolite), anorthite (var. "indianite") apatite, beryl, beryl (yellow), brucite, chalcedony (var. carnelian, and jasper), chlorite, chloritoid, chromite, clinocllore, corundum, culsageeite (related to jefferisite), damourite, deweylite, diaspore, euphyllite (a hydrous soda-potash mica for which Unionville is the type locality), garnet, gibbsite (hydrargillite), halloysite (kerolite), hematite, ilmenite, jefferisite, "lesleyite," limonite, magnetite, malachite, margarite ("corundellite"), muscovite, oligoclase, orthoclase (adularia), pattersonite (a hydrous magnesia-iron mica), pyrite, pyroxene (var. diallage), quartz (drusy and green), rutile, serpentine (var. retinalite, antigorite, picrolite and precious serpentine), spinel, talc, tourmaline and zoisite, including var. "unionite."

PROCEEDINGS OF SOCIETIES

NEW YORK MINERALOGICAL CLUB

Annual Meeting, 1921

The Annual Meeting of the New York Mineralogical Club was held in the Academy Room of the American Museum of Natural History on the evening of April 20th, at 8.15 P.M. The President, Dr. George F. Kunz, presided, and there was an attendance of 23 members.

The following names were submitted to the Committee on Membership:—Mr. Everett D. Carlson, Miss Ethel M. Egan and Mr. Frederick M. Taylor.

Mr. Manchester showed a cut citrine from the Portland Quarry, Portland, Conn., weighing 134 carats.

The Treasurer submitted a report for the year showing a balance of \$417.43, and spoke of the advisability of increasing the dues. The Club declined to act on this, however. A committee of three was then appointed to prepare a slate of officers for the coming year.

The question of an excursion for Decoration Day was then taken up. Dr. Allen suggested Texas, Pa., and after discussion, the matter was submitted to the Committee on Excursions.

The Committee on Nominations then submitted the following nominations for Officers for the year 1921–1922:—

For President—Dr. George F. Kunz.

For Vice-President—Mr. George E. Ashby.

For Corresponding Secretary—Dr. Wallace Gould Levison.

For Recording Secretary—Mr. Herbert P. Whitlock.

For Treasurer—Mr. Gilman S. Stanton.

In the absence of other nominations, these officers were elected.

The President announced that he had been named on the Committee to arrange for the purchase of one gram of radium to be presented to Madame Curie, and that Madame Curie would attend a joint reception, tendered by the American Museum of Natural History, the New York Academy of Science and the New York Mineralogical Club, on May 17th. The following Committee for this reception was appointed from the Club:—Dr. George F. Kunz, Chairman, Prof. Alexander H. Phillips, Mr. O. Ivan Lee, Mr. Herbert P. Whitlock, and Miss Agnes V. Luther.

Dr. Frederick D. Allen then read a paper on “Marmolite and Brucite from Hoboken.” He stated that marmolite was named in 1822 by Thomas Nuttall on material from Hoboken. He called attention to the fact that some specimens from Hoboken which have been so labeled show deposition from solution without structure. Nuttall speaks of his mineral as occurring with brucite, and named it marmolite on account of its foliated texture, giving a careful description of its laminated and frequently radiated structure. Later analyses of “marmolite” show perfectly normal serpentine. Brucite was noticed by Archibald Bruce in 1810 in the American Mineralogical Journal as “native magnesia from New Jersey.” He determined the water content to be 30 per cent. Dr. Allen concludes that what Nuttall called marmolite was serpentine pseudomorphous after lamellar brucite.

Mr. Wintringham asked if it were possible to study Nuttall's original material. He discussed types of serpentine pseudomorphs from Tilly Foster, and read the article on them by Dana in the American Journal of Science. A vote of thanks was tendered to Dr. Allen for his highly suggestive paper.

HERBERT P. WHITLOCK, *Recording Secretary.*

NOTES AND NEWS

The Research Information Service of the National Research Council is prepared to assist investigators by locating scientific publications which are not generally or readily accessible. Their address is 1701 Massachusetts Ave., Washington, D. C.

Dr. C. Anderson, who has been Mineralogist in the Australian Museum since 1901, has been appointed Director of the Museum. We extend him our congratulations.

Mr. Edw. F. Holden of Hillsboro, N. H., has been appointed instructor in mineralogy at the University of Michigan, and his address should be changed accordingly in the list of members of the M. S. A.

Another change in address has been reported: Mr. John Holzmann is now at 23 Demarest St., Newark, N. J.

The publication "Lefax" has issued an elaborate table for the recognition of amphiboles and pyroxenes, by Professor Alfred C. Lane. It contains a large amount of information on these minerals, especially modern optical data, condensed into very small compass.

Ilmenite in Rhode Island.—Mr. James G. Manchester has recently discovered good crystals of ilmenite, about 1 cm. in diameter, in the quarry of the Providence Crushed Stone and Sand Co., Cortez St. and Manton Ave., Providence, R. I., easily reached by the Manton Ave. trolley car. This appears to be a new mineral to the State.

The U. S. Bureau of Mines has published a mimeographed report on Iceland Spar, prepared by Dr. Oliver Bowles, Mineral Technologist (Serial No. 2238). It comprises data on the properties, uses, and value of the material, and descriptions of a number of occurrences. The Iceland mine is described in detail, with reference to paper by H. H. Eiriksson, "The spar mine at Helgustadir, Iceland," *Trans. Inst. Mining Eng. London*, 59, 56, 1920. A new occurrence of the material is announced, in the Warner Range near Cedarville, Modoc Co., California. The deposits near Greycliff and Big Timber, Sweet Grass Co., Montana, are also fully treated. Finally, notes on occurrences in Spain and Argentina are given.

We regret to note the deaths of Professor M. E. Wadsworth, the eminent American petrologist and mineralogist, and of M. Adolphe Carnot, the French chemist, after whom the mineral carnotite was named.

NEW MINERAL NAMES—

DOUBTFUL SPECIES, VARIETIES, ETC.

FAMILY 4. OXIDES, ETC.

Chromohercynite.

A. LACROIX: A new member of the spinel group, chromohercynite, from Madagascar. *Bull. soc. franc. min.*, **43**, 69–70, 1920.

NAME: From the composition, *chromite* plus *hercynite*.

PHYSICAL PROPERTIES: Color black; luster vitreous; sp. gr. 4.415.

CHEMICAL PROPERTIES: An isomorphous mixture of chromite and hercynite in equimolecular proportions, essentially $\text{FeCr}_2\text{O}_4 \cdot \text{FeAl}_2\text{O}_4$, with some replacement of the Fe by Mg. Analysis gave: Cr_2O_3 38.64, Al_2O_3 27.12, Fe_2O_3 0.61, FeO 27.00, MnO 1.10, MgO 5.33, SiO_2 0.28, H_2O 0.25, sum 100.33 per cent.

DISCUSSION. [May be classed as a subspecies or variety of hercynite or iron-spinel.] E. T. W.

FAMILY 5. CARBONATES, ETC.

Patagosite

STANISLAS MEUNIER: Observation on the mineralizing calcite of certain fossils. *Compt. rend. somm. soc. géol. France*, **1917**, April 2, 83–84.

NAME: From the Greek *patagos*, which means, rhetorically, an explosion.

PROPERTIES: Shows rhombohedral cleavage, and on solution in acid leaves a dark colored residue of organic nature. Characterized by exploding violently on heating.

DISCUSSION. [At least 50 other minerals are known to explode on heating, in occasional specimens. If some young mineralogist is looking for a job, he can work up a name for each of these instances. Whether this will lead to his becoming famous, or to violent explosions on the part of other mineralogists, we will not venture to predict.] E. T. W.

FAMILY 7. PHOSPHATES, ETC.

Acid aluminium phosphate.

B. DE C. MARCHAND: Occurrence of a peculiar phosphate of aluminium in a deposit of bat guano. *S. African J. Sci.*, **15**, 638–639, 1918; thru *Chem. Abstr.*, **14** (9), 1280, 1920.

PHYSICAL PROPERTIES: Color white to slightly yellowish; amorphous, soft.

CHEMICAL PROPERTIES: Insoluble in acids, but half the P_2O_5 is soluble in NH_4OH . Analysis of "selected samples" gave the ratio $\text{Al}_2\text{O}_3 : 2\text{P}_2\text{O}_5 : 8\text{H}_2\text{O}$.

DISCUSSION: [This is obviously a colloidal adsorption product of indefinite composition, and should not be given a species name or classed as a definite mineral.] E. T. W.

Duftite

O. PUFÄHL: Mitteilungen über Mineralien und Erze von Südwestafrika, besonders solche von Tsumeb. (Notes on minerals and ores from Southwest Africa, especially those from Tsumeb.) *Centr. Min. Geol.*, **1920**, (17/18), 289–296; this mineral, 295–296.

NAME: In honor of Mining Councilor G. Duft, Director of the Otavi Mine and Railroad Co.

PHYSICAL PROPERTIES: Color olive green to grayish green; in aggregates of small crystals with curved, rough faces. Sp. gr. = 6.19; H = 3.

CHEMICAL PROPERTIES: Before the blowpipe decrepitates and gives tests for As and Pb. Readily soluble in acids. Analysis gave: PbO 50.10, CuO 19.32, ZnO 0.46, CaO 0.75, As_2O_5 26.01, H_2O - 0.08, H_2O + 2.65, SiO_2 0.44, sum 99.81 per cent. This is thought to correspond to $2Pb_3(AsO_4)_2 : Cu_3(AsO_4)_2 : 4Cu(OH)_2$.

OCCURRENCE. Occurs associated with azurite crystals and coated with bauxite-like material, on a specimen brought back from the Tsumeb region in 1911 by the late mining engineer Zeleny.

DISCUSSION: [This may be a member of the olivenite group, but until better data are obtained, it is to be retained in the doubtful class. At any rate the formula corresponding to the analysis is evidently simply $PbCu(OH)(AsO_4)$.]
W. F. F.

ABSTRACTS—CRYSTALLOGRAPHY

THREE MINERALOGICAL NOTES—(CALCITE, QUARTZ, SPHALERITE). G. AMINOFF. *Geol. Fören. Förh.*, **38**, 201-211, 1916.

Comprises crystallographic descriptions of a parallel-growth of calcite from Garta, Arendal, with one new form (19.1.20.0); a quartz hetero-twin after the Zinnwald law from Offerdalen, Jämtland; and colorless tetrahedrons of sphalerite from Slättberg, Dalarne, Sweden.
E. T. W.

CALCITE TWINS FROM FÄRÖARNA. G. AMINOFF. *Geol. Fören. Förh.*, **38**, 339-348, 1916.

A detailed crystallographic description. Deviations from the theoretical twinning position are considered, and found to amount to up to 15', there being proportionality between amount of deviation and number of observations.
E. T. W.

TWO NEW OCCURRENCES OF WELL CRYSTALLIZED SWEDISH MINERALS. GUST. FLINK. *Geol. Fören. Förh.*, **38**, 463-472, 1916.

Inesite is described from Långban in tabular crystals with a , b , and f the dominant forms. Apophyllite from the Dannemora mines is in tabular crystals with a number of modifying forms.
E. T. W.

CRYSTALLOGRAPHIC STUDIES OF PHENYL BENZOATE. MARIA STURA. *Riv. min. crist. Ital.*, **48**, 86-90, 1917.

The system is monoclinic; crystallographic data are given. E. T. W.

THE CRYSTAL STRUCTURE OF THE ALUMS AND THE RÔLE OF WATER OF CRYSTALLIZATION. C. SCHAEFER AND M. SCHUBERT. *Ann. Physik*, **55**, 397-400, 1918; **59**, 583-588, 1919; L. VEGARD, **58**, 291-296, 1919.

Continuation of discussion; compare *Am. Min.*, **4** (8), 103, and **5** (7), 139.
E. T. W.

THE LAWS OF CURIE AND HAÛY. C. VIOLA. *Bull. soc. franc. min.*, **41**, 108-116, 1918; G. FRIEDEL, **41**, 196-198, 1918.

A mathematical discussion, in which the so-called law of Curie is questioned.
E. T. W.

ABSTRACTS—MINERALOGY

INVESTIGATIONS ON SWEDISH APATITES. KARL A. GRÖNWALL. *Geol. Fören. Förh.*, **38**, 411–434, 1916.

Apatite from Nordmarken is described in detail. Analysis shows it to be a nearly pure fluorapatite (Cl only 0.05%); its sp. gr. = 3.194. The crystals are tabular to prismatic with a number of pyramids, and the best value for c is 0.7326. Optical measurement gave (for D): $\omega = 1.638$, $\epsilon = 1.635$. Comparisons are made with many other occurrences. A crystal of the same from Bolandsgrufvan is nearly bipyramidal, with numerous modifying faces; it gave $c = 0.7333$.

E. T. W.

NEW MINERAL ANALYSES. HERMAN HEDSTRÖM. *Geol. Fören. Förh.*, **38**, 435–440, 1916.

Comprises apophyllite from the Harstig mine, melanotekite from Harstig and from Jakobsberg, and manganophyllite from Alnön, Sweden.

E. T. W.

OLIVINE FROM ETNA. F. STELLA STARRABA. *Rend. mem. accad. sci. Acireale*, [3], **9**, 41–65, 1917; thru *J. Chem. Soc. and Chem. Abstr.*, **15** (9), 1270–1271, 1921.

Analyses are given of two types of olivine, both rather high in FeO and in Fe₂O₃. Increase in Fe content deepens the color and raises the sp. gr. and refractive indices.

E. T. W.

MINERALOGICAL NOTES, II and III. NILS ZENZÉN. *Geol. Fören. Förh.*, **38**, 477–480, 1916.

A specimen of ganomalite analyzed by Lindström has been relocated. It proves to have double refraction 0.050, and to have distinct hexagonal cleavage. The indices of microcline from Tunaberg have been measured, giving: α 1.5182, β 1.5223, γ 1.5253.

E. T. W.

THE HARDNESS SCALE FROM 4 TO 5. P. J. HOLMQUIST. *Geol. Fören. Förh.*, **38**, 501–520, 1916.

There is considerable discrepancy in the recorded data as to the relative hardness of apatite and fluorite, which are respectively 5 and 4 in the usual hardness scale, some measurements making fluorite the harder. It is interesting to note that while minerals with H 2–3 and 5–6 are abundant (nearly 25 per cent. of each), there are only 16 per cent. with H 3–4 and less than 15 per cent. with H 4–5. Extensive grinding experiments were made, and it was found that apatite on face (10 $\bar{1}$ 0) is 1½ times as hard as fluorite on (111) if steel powder is used as the abrasive. The harder the abrasive used, however, the relatively harder fluorite seems. It is probable that fluorite may in fact be the harder mineral. These peculiarities are no doubt connected with the greater perfection of the cleavage in fluorite. Evidently the usually accepted hardness scale needs improvement.

E. T. W.

THE GRINDING HARDNESS OF MINERALS. L. H. BORGSTRÖM. *Geol. Fören. Förh.*, **41**, 448–453, 1919.

The results described in preceding abstract are confirmed and extended, and it is found also that time of grinding is an important factor, the longer the time the greater the contrast in hardness of minerals adjoining one another in the scale.

E. T. W.